US-PAT-NO: **5374952**

DOCUMENT-IDENTIFIER: US 5374952 A

TITLE: Videoconferencing system

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The term "television signal" or "TV signal", as used herein, is intended to mean a conventional (NTSC or other standard) analog signal, which includes both
a video and an audio portion, and/or any other standard or non-standard representation of video and/or audio information including digitally encoded information (**compressed** or uncompressed). The terms "video signal" and "audio signal" will be used to separately denote only the video portion and audio portion, respectively, of the television signal. As is well known, for NTSC standards, the video portion lies within a frequency range of 0 to 4.75 MHz whereas the audio portion lies within a frequency band of 0 to 15 KHz. As desired, these video and audio signals are typically combined and modulated upward from baseband to a 6 MHz wide (in Europe, a 7 MHz wide) frequency

channel within a broadband spectrum of 30 to 800 MHz.

For a connection to the "outside world" beyond the LAN, a modulating and demodulating circuit board 24 is required to convert to and from baseband video signals. The signals to be transmitted outward are digitized and **compressed,** and the signals received from beyond the LAN are **decompressed** and converted to analog video, in a conventional codec 28. The digital signals are transmitted and received on the telephone network via an adaptor 30 using a digital network service such as ISDN or the like.

FIG. 21 illustrates an embodiment in which the television signal is digitized and **compressed** prior to transmission on the B-LAN cable. FIG. 21A shows that the analog video and audio signals received from the camera 190 and microphone 192, respectively, are passed to analog to digital converters 194 and 196. The outputs of these two A/D converters are multiplexed and **compressed** in a digital encoder 198. The output of the encoder 198 is passed to the RF modulator 200 which receives the selected carrier signal from the voltage control oscillator (VCO) 202 controlled by the workstation computer.

14. The videoconferencing network defined

in claim 1, wherein said video signal and said audio signal are digital signals; wherein said modulator includes a digital compression stage, connected to receive said digital signals, for producing **compressed** video and audio digital signals, said modulator being operative to superimpose said digital signals on a selected carrier to produce a digital television signal.

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The U.S. Pat. No. 4,935,924 to Baxter discloses a signal distribution cable network in which information signals from different signal sources, such as cable television, FM **radio,** videotape recorder, video camera and compact disk player, are transmitted on a common cable at different frequency channels. A single channel allocation "controller" is connected on the cable and transmits channel selection signals on the cable to both the information sources and the information users (receivers) to control the channel allocation. Again, no videoconferencing capability is contemplated or disclosed.

The B-LAN can be implemented by providing an **RF** or CATV cable which interconnects all computer stations in the network. Alternatively, the aforementioned V-coupler (or equivalent) can be provided so that the broadband

television information can be transmitted over the same physical communication layer as the baseband data. Hereinafter this physical layer, which can be a shielded or unshielded twisted pair wire, for example, will be designated as the "LAN cable".

FIG. 6 is a block diagram of an **RF** modulator circuit according to the preferred embodiment of the present invention.

The television signals are modulated into the proper channel for transmission on the B-LAN, under control of data signalling messages received on the A-LAN, by an **RF** modulator within a television control circuit board 24 located at each workstation. This same circuit board contains a tuner and demodulator for receiving the television signal on a selected channel on the B-LAN and demodulating this signal into the separate baseband video and audio signals for displaying an image and producing sound at the respective workstation. If the particular unit is to serve only as a source, a separate circuit board 26 may be provided which does not contain the tuning and demodulating capability. Similarly, if the unit is to serve only as a receiver, the circuit board does not require a modulator.

Television signals received either via the **RF** network cable 64 or the LAN cable 66 and V-coupler 68 are passed to an **RF** demodulator 70 which is tuned to the desired channel by a control signal from a microprocessor 90. The baseband video signal is passed to a video/audio input/output control 84 (FIG. 5A), to an NTSC to red, green and blue converter 74 and then to a video window controller 76. The audio portion of the composite television signal is supplied through an audio signal control 86 (FIG. 5B) to an amplifier (not shown) which drives a speaker in the camera unit 11 or a telephone handset 73.

Conversely, the video signal received from the camera unit 11 is passed through a video signal control 88 (FIG. 5B) to an **RF** modulator 80. The audio signal received from a microphone in the camera unit is also passed through the audio signal control to the **RF** modulator 80. This audio signal may be sampled and digitized in an A/D converter in an audio processor 92 and then supplied to the PC for storage on a hard disk for subsequent retrieval and "playback". The retrieved digital signal is passed to a D/A converter in the processor 92 and then transmitted via the audio signal control 86 to the speaker or handset, or to the audio input of the modulator 80.

The **RF** modulator 80 combines the video and analoq signals into a 6 MHz wide baseband composite television signal and places this signal on a selected frequency channel for transmission via the **RF** network (video cable 64). The channel frequency is selected and supplied to the **RF** modulator by the microprocessor 90.

A preferred implementation of the **RF** modulator is shown in FIG. 6. A preferred embodiment of the video window controller is illustrated in FIG. 7. The integrated circuit chip part numbers used in these circuits, and their manufacturing sources, are set forth in the Table below:

FIG. 6 shows in detail how the audio and video signals are placed on a selected frequency channel for transmission to another workstation. The **RF** modulator, which can be either a TDA 5667 or SL 5770 integrated circuit, places the audio and video signals on separate carriers, that is, a 45.75 MHz video carrier and a 41.25 MHz audio carrier. The center frequency of this channel is 44 MHz.

The system of FIG. 20 provides a solution to the restriction that a single cable provides only a limited number of channels. As is indicated in this figure, the number of available channels

can be doubled, tripled, etc. by providing a multiplicity of cables 1, 2 . . . N in parallel. In this case, an **RF** switch 182 is connected to the tuner and modulator of each workstation to provide connection to the proper cable. The position of the **RF** switch is controlled by the CPU of each workstation.

When operating with multiple CATV cables, it is necessary to broadcast the cable number along with the selected frequency channel in a channel request message and a call request message. Upon receipt of a call request message indicating a particular cable number and channel, a workstation will set its **RF** switch to receive a television signal from the particular, selected cable.

FIG. 21 illustrates an embodiment in which the television signal is digitized and compressed prior to transmission on the B-LAN cable. FIG. 21A shows that the analog video and audio signals received from the camera 190 and microphone 192, respectively, are passed to analog to digital converters 194 and 196. The outputs of these two A/D converters are multiplexed and compressed in a digital encoder 198. The output of the encoder 198 is passed to the **RF** modulator 200 which receives the selected carrier signal from the voltage control oscillator (VCO) 202 controlled by the workstation

computer.

Through digital encoding and compression or other analog techniques it is possible to reduce the bandwidth of the **RF** frequency channel. It is accordingly possible to increase the number of channels transmitted on a single CATV cable. This arrangement may avoid the need for providing multiple cables in the manner shown in FIG. 20.

FIG. 24 illustrates a relatively simple and inexpensive circuit for securing the video information against unauthorized access. As explained above, it is possible to secure the **RF** signal against monitoring by a conventional television set by either inverting the video signal or by transmitting the audio signal in AM, where FM transmission is the standard, or FM where AM transmission is the standard.

The circuit of FIG. 24A may be inserted in the video signal stream to "scramble" the video signal prior to **RF** modulation. This circuit comprises a sync extractor 230 which passes timing signals to a microprocessor 232. The microprocessor generates control signals which are passed to a scrambling circuit 234. The scrambling circuit adds (or subtracts) a different DC voltage to each successive scan line, inverts the

signal of every other scan line, or effects some other simple change that causes the image to "disappear" if displayed without descrambling.

As explained above, the videoconferencing capability of the station requires a camera, microphone and speaker, as well as an **RF** modem (modulator/demodulator) 260 connected to one or more **RF** cables, for example, through an **RF** switch as prescribed in connection with FIG. 20. In this embodiment, signalling is provided on a separate data channel, as described above in connection with FIG. 18B. All functions of the unit are controlled and coordinated by a central processing unit 262 which executes software stored in memory 264.

TABLE

Manufacturers Integrated Circuits

Media Computer Technologies, Inc. Part No. MVM 121A 3160 De La Cruz Blvd. (PC Video) Santa Clara, CA 95054 Philips Semiconductors Part No. TDA 5512 T 2001 W. Blue Heron Blvd. (synthesizer) P.O. Box 10330 Part No. TDA 8708 Riveria Beach, FL 33404 (analog to digital converter) Part No. SAA 9051 (digital multistandard decoder) Part No. SAA 7197 (phase locked loop) Seimens Components, Inc. Part No. TDA 5667

Integrated Circuits Division (**RF** Modulator) 10950 North Tantau Avenue Part No. SL 5770 Cupertino, CA 95014 (**RF** Modulator) Motorola Corp. Part No. MC 13176 Phoenix, AR (SAW stabilized oscillator)

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3. The videoconferencing network defined in claim 1, wherein said A-LAN and said B-LAN are divided into a plurality of work groups, said network further comprising an **RF** bridge connecting the B-LAN of one group with the B-LAN of another work group, for changing the frequency channel of the television signals transmitted on said B-LAN from one work group to another.

4. The videoconferencing network defined in claim 3, wherein said **RF** bridge includes a plurality of controllable switches connected in parallel, each switch being operative to change the frequency channel of one television signal from a selectable first channel to a selectable second channel.

5. The videoconferencing network defined in claim 4, wherein said **RF** bridge further includes a processor, responsive to data messages transmitted on said A-LAN, for controlling said plurality of switches to select said first and second channels.

16. The videoconferencing network defined in claim 1, wherein said A-LAN and said B-LAN are divided into a plurality of work groups, with each work group having assigned thereto a plurality of private channels for exclusive use within the work group plus at least one bridge output frequency channel and at least one bridge input frequency channel, the network further comprising an **RF** bridge, connecting the B-LAN of one group with the B-LAN of another work group, for passing only television signals on the bridge output channels from a given work group and passing only television signals on the bridge input channels to said given work group.

17. The videoconferencing network defined in claim 16, wherein said **RF** bridge further comprises two frequency bandpass filters connected in parallel, one bandpass filter operative to pass the frequency range of the bridge output channels and the other bandpass filter operative to pass the frequency range of the bridge input channels.

39. The videoconferencing network defined in claim 38, wherein said B-LAN includes a plurality of CATV cables arranged in parallel and an **RF** switch, coupling each CATV cable to the second input/output port of each station, for

selecting the CATV cable which is connected to said input/output port.